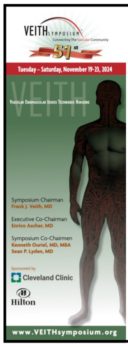


How To Treat Type 1 Endoleaks After EVAR: When Cuff, When F/EVAR, When Chimney, When Open Conversion: What About Embolization

M Orrico, MD
San Camillo-Forlanini Hospital, Rome

Management of Endoleaks After Elective Infrarenal Aortic Endovascular Aneurysm Repair
A Review
Sebastian Cifuentes, MD; Bernardo C. Mendes, MD; Armin Tabiei, MS; Salvatore T. Scali, MD; Gustavo S. Oderich, MD; Randall R. DeMartino, MD, MS

JAMA Surgery September 2023

- Incidence 8%
- Accounts for 12% of all ELs
- Rupture Risk 4-7.5% @ 2 yrs
- Risk Factors out of IFU repair & hostile neck (large, short, angulated, or reverse tapered aneurysmal neck, mural neck thrombus, or calcification) large AAA diameter

SOCIETY FOR VASCULAR SURGERY® DOCUMENT

The Society for Vascular Surgery practice guidelines on the care of patients with an abdominal aortic aneurysm

Journal of Vascular Surgery
January 2018

We recommend treatment of type I endoleaks.	
Level of recommendation	1 (Strong)
Quality of evidence	B (Moderate)

Editor's Choice – European Society for Vascular Surgery (ESVS) 2024 Clinical Practice Guidelines on the Management of Abdominal Aorto-Iliac Artery Aneurysms

Recommendation 103 — Unchanged

Patients with Type 1 endoleak after endovascular abdominal aortic aneurysm repair are recommended for prompt re-intervention to achieve a seal, primarily by endovascular means.

Class	Level	References
I	B	Antoniou et al. (2015),[790] Schlösser et al. (2009),[792] Doumenc et al. (2021),[798] Budtz-Lilly et al. (2023),[806] Rajendran and May (2017)[820]

Recommendation 104 — New

Patients with compromised sealing zones* without visible endoleak after endovascular abdominal aortic aneurysm repair may be considered for intervention to improve the seal, primarily by endovascular means.

Class	Level	References
IIb	C	Budtz-Lilly et al. (2023),[806] Bastos Gonçalves et al. (2013),[821] Bastos Gonçalves et al. (2014),[822] Baderkhan et al. (2018),[823] Geraedts et al. (2021)[824]

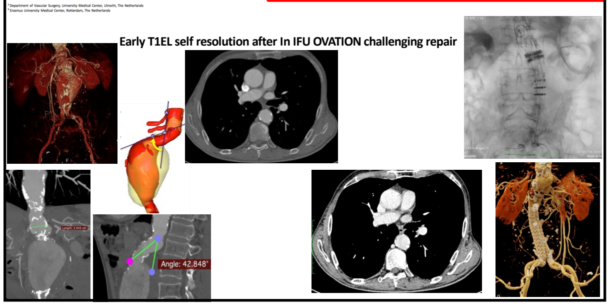
* Inadequate seal (< 10 mm) or progressive neck dilatation.

Spontaneous Delayed Sealing in Selected Patients with a Primary Type-Ia Endoleak After Endovascular Aneurysm Repair

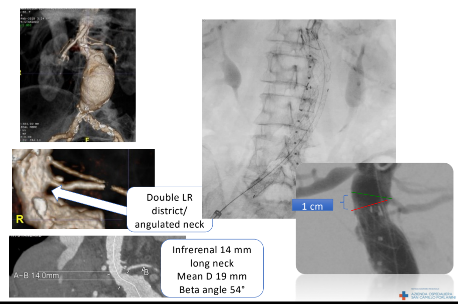
F. Bastos Gonçalves [a,b,*], H.J.M. Verhagen [b], K. Vasanthananthan [a], H.J.A. Zandvoort [a], F.L. Moll [a], J.A. van Herwaarden [a]
[a] Department of Vascular Surgery, University Medical Center, Utrecht, The Netherlands
[b] Erasmus University Medical Center, Rotterdam, The Netherlands

Conclusions: All but one of the primary type-Ia endoleaks sealed spontaneously. Until sealing, the risk of rupture persisted, but subsequently only one recurrence of type-Ia endoleak was seen. In selected patients, a conservative approach for primary type-Ia endoleaks may be justified.

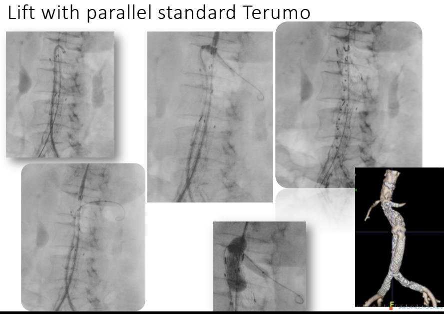
Early T1EL self resolution after In IFU OVATION challenging repair



T1A Endoleak → IR neck loss @ Outer Curve



LRA cath. w Oscor Destino 7F (18 mm curve)
Lift with parallel standard Terumo



Late/Persistent T1A EL Rate in latest series

ENDOGRAFT	Type 1 A endoleak rate before 2020	Type 1 A endoleak rate before 2020
Gore C3 excluder	2.2% Tsolakis JVS 2018	0% Yamanouchi JVS 2024
Endurant II	3.8% Troisi JCST 2019	1.9% Georgiadis JVS 2023 *(EXCC)*
Cook Zenith	13% Suvi Vaaramaki EJVES 2019	0.8% Fujimura 2024
Ovation	4.2% Swerdlow JVS 2019	1.4% Leyden JVS 2023 (ALTO)
Incraft	3.4% Torsello JVS 2018	
AFX	3.3% Welborn JVS 2014	1,7% Hoshina JVS 2023
TREO	2.7% Marone Ann Vasc Surg 2019	
Nellix	36.5%Stenson JVS 2019	

Towards an entirely endovascular aortic world:
an update of techniques and outcomes for endovascular
and open treatment of type I, II, and III endoleaks

Nicola MANGIALARDI [1], Matteo ORRICO [1, 2 *], Sonia RONCHEY [1],
Barbara PRAQUIN [1], Vittorio ALBERTI [1], Carlo SETACCI [1, 2]

The Journal of Cardiovascular Surgery 2016 October; 57(5):688-711

Type 1 A endoleak

- Palmaz Stent
- FEVAR/BEVAR/ Ch-EVAR
- Coils/Glue
- Heli-FX
- Cuff
- Conversion

Towards an entirely endovascular aortic world:
an update of techniques and outcomes for endovascular
and open treatment of type I, II, and III endoleaks

Nicola MANGIALARDI [1], Matteo ORRICO [1, 2 *], Sonia RONCHEY [1],
Barbara PRAQUIN [1], Vittorio ALBERTI [1], Carlo SETACCI [1, 2]

The Journal of Cardiovascular Surgery 2016 October; 57(5):688-711

Type 1 A endoleak

- Endo unfeasibility /failed attempts
- Graft close to RA/LSA
- Distal Migration
- Non dilated neck/ slight dilation
- Proximal evolution
- Conversion
- Cuff
- Heli-FX
  - -Kinked neck
  - -Non calcified native aorta
  - -Distance graft aorta <2mm
- Coils/Glue
  - -Posterior leak
  - -Calcification
  - -Small comunication between the graft and the aorta
- Palmaz Stent
  - -Straight neck
  - -Thrombus
  - -Lack of circumf adherence
- FEVAR/BEVAR / Ch-EVAR
- Proximal evolution
- FEVAR/BEVAR/

Cuffs & Type 1 A endoleak

Select early type IA endoleaks after endovascular aneurysm repair will resolve without secondary intervention

Thomas F. X. O'Donnell, MD, Michael R. Corey, MD, Sarah E. Deery, MD, Gregory Tsougranis, BS, Rohit Maruthi, BS, W. Darrin Clouse, MD, Richard P. Cambria, MD, and Mark F. Conrad, MD, MMSc, Boston, Mass

Journal of Vascular Surgery
January 2016

(47 pts treated by prox cuff for type IA endoleak)

TECHNICAL SUCCESS **100%**

Management of endoleak after endovascular aneurysm repair: Cuffs, coils, and conversion

Sheehan K et al, J Vasc Surg 2004

(30 pts treated by prox cuff for type IA endoleak)

MORTALITY

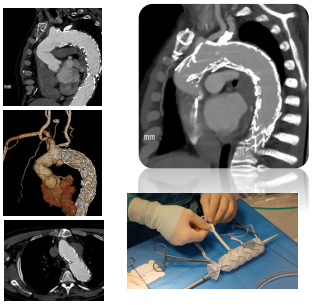
TECHNICAL SUCCESS **96,6% (29/30)**

- 1 OPEN CONVERSION

Late migration after EVAR with Excluder
treated with Cook Flex Cuff

Najuta for t1EL

Home Made F-TEVAR for t1EL



FEVAR for type 1 endoleak

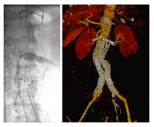
Fenestrated Endovascular Aortic Repair After Failed Endovascular Aortic Repair

Fadi Taher, MD[1], Markus Plimon, MD[1], Corinna Walter, MD[1], Gabriel Weiss, MD[1], Miriam Klinger, MD[1], Afshin Assadian, MD[1], and Juergen Falkensammer, MD[1]

Journal of Endovascular Therapy 2023

Table I. Demographic Patient Data, Surgical Parameters, and Technical Complications in Fenestrated Endovascular Aortic Repair After Endovascular Aortic Repair Patients (n=35).

	Mean ± standard deviation (range), ratio or absolute number (%) given
Age at surgery in years	76.7 ± 6.5 (range 54-89)
Gender female: male	4:31
Number of fenestrations	3.8 ± 0.7 (range 2-5)
Duration of surgery in minutes	301.1 ± 110.5 (range 150-547)
Total number of patients with technical complication	7 (20%)
Patients with unconnected fenestrations	3 (8.6%)
Patients with bleeding complication	2 (5.7%)
Patients with access or target vessel dissection	2 (5.7%)
Primary technical success	32 (91.4%)
Assisted technical success	33 (94.3%)



Fenestrated Stent-Grafts for Salvage of Prior Endovascular Abdominal Aortic Aneurysm Repair

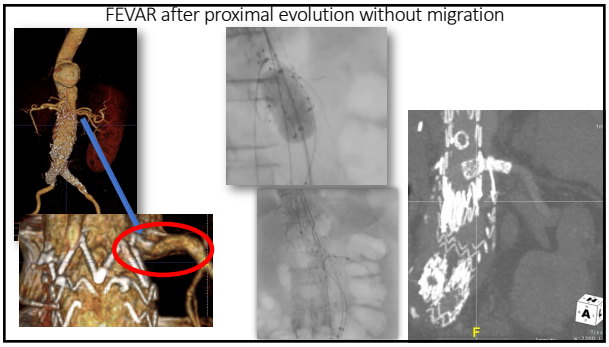
A. Katsargyris [1], O. Yozar [1,2], K. Oikonomou [1], F. Bekkema [1], I. Tiellis [1], E.L.G. Verhoeven [1,3,*]

FEVAR for T1AEL: Technical Issues

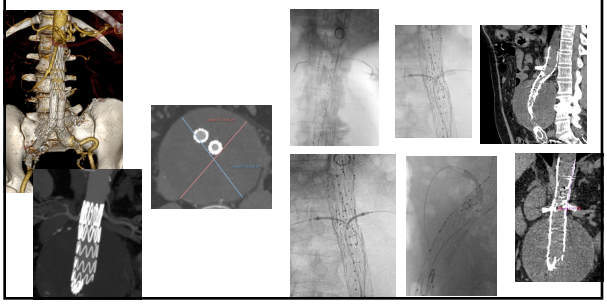
- Marker Overlapping
- Presence of transrenal stent
- Reduced Trackability
- Short distance between RA and flow divider (if not dilated)

- Technical success 58,3-92,3%
- Target vessel failure 5,4-8%

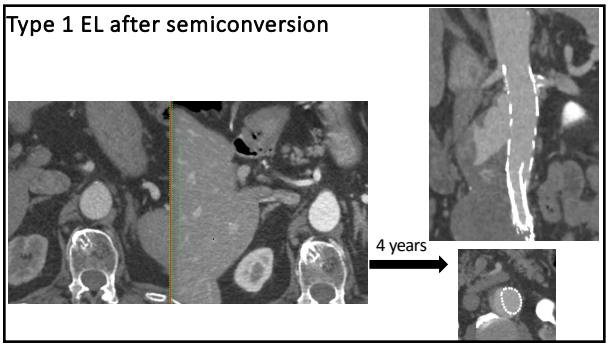
FEVAR after proximal evolution without migration



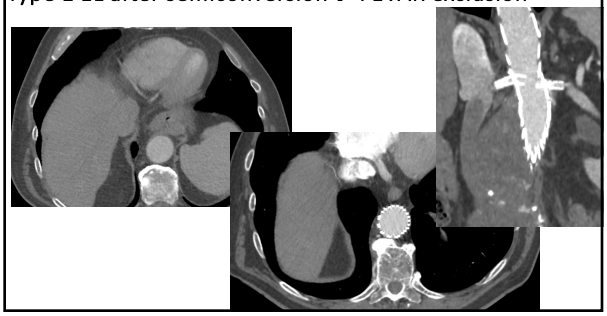
Type 1 EL in previous suprarenal EVAR cannulation throught the free-flow



Type 1 EL after semiconversion



Type 1 EL after semiconversion→ FEVAR exclusion



Late failure of a Nellix endoprosthesis treated with the t-Branch off-the-shelf multibranched stent graft

Antonio Loria, MD, Matteo Orrico, MD, Mario Mariny, MD, Alessio Vona, MD, Sonia Ronchey, MD, PhD, and Nicola Mangialardi, MD, Rome, Italy

Journal of Vascular Surgery Cases and Innovative Techniques
December 2019

PARARENAL DIAMETER EVOLUTION

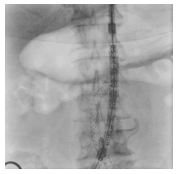
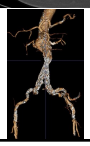


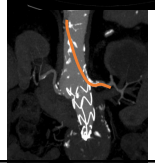
Fig 1. Postoperative three-dimensional volume rendered image showing the correct t-Branch positioning with the branches' iliac axis patency and aneurysm exclusion.

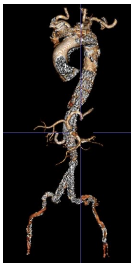
Large Aortic Diameter at renal level

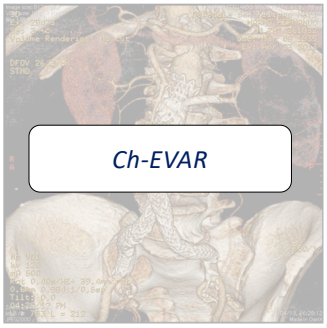
T1EL with Free Flow → RA difficult to access from below

t-branch repair in PAA afer EVAR → Large aortic diameter + free flow at renal level









J Endovasc Ther. 2018 Aug;25(4):492-498. doi: 10.1177/1526602818782941. Epub 2018 Jun 18.

Collected Transatlantic Experience From the PERICLES Registry: Use of Chimney Grafts to Treat Post-EVAR Type Ia Endoleaks Shows Good Midterm Results.

Ronchey S[1], Fazzini S[1], Scali S[2], Torsello G[3], Kubilia F[2], Veith F[4,5], Donas KP[3], Pecoraro F[4,6], Mangialardi N[7].

517 Ch-EVAR/ 898 CGs
(13 centers)

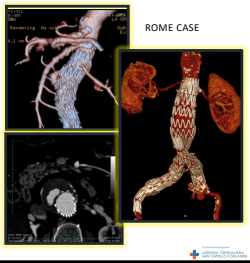
39 Ch-EVAR/ 70 CGs
For Type IA endoleak

ROME CASE

PERICLES and EL-IA > **39 CASES (70 CHIMNEYS)**
in 7 international centers

Demographics

	n – (%) or mean +/- SD
Age (yrs)	76.2 ± 7.6
Male	25 – 83.3%
ASA III	20 – 51.3%
ASA IV	19 – 48.7%
Cause for EL-IA	
Neck degeneration	21 – 53,8%
Migration	18 – 46,2%
Indication	
Juxtarenal AAA	32 – 82.1%
Suprarenal AAA	5 – 12.8%
Type IV TAAA	2 – 5.1%
AAA anatomical features	
Infrarenal neck diameter (mm)	27.0 ± 5.2
Infrarenal neck length (mm)	3.9 ± 4.0
AAA diameter (mm)	71.5 ± 29.0



ROME CASE

PERICLES and EL-IA > **39 CASES (70 CHIMPS)**
in 7 international centers

Operative variables

	Total n	Missing (n) if obs	n – (%) or mean +/- SD
Types of chimney grafts (n=70)			
Balloon-expandable covered			31 - (44.2)
Self-expanding covered			34 - (48.5)
Balloon-expandable bare metal			5 - (7.1)
Realining w/ bare metal stent			20 - (28.5)
Technical Success	35		89.7%
Type I Endoleak			7 – 18.0%
Type Ia			4 – 10.3%
Type Ib			3 – 7.7%
Treated type Ia/Ib endoleak			6 – 15.4%

PERICLES and EL-IA > **39 CASES (70 CHIMPS)** in 7 international centers

Outcomes	n – (%) or mean (SD,range)	p
Follow-up (months)		
Time to last CTA/MRA	21.9 – (0.23 – 72.3)	
Anatomy		
New neck length	20.4 ± 4.2	
Post-op max AAA Ø decrease 1,6	0,486	
Mortality (n=3) (1 cardiac-2 pneumonia)		
30-day	1 – 2.6%	
Overall	3 – 7.7%	
Any complication (n=8)		
Late type I endoleak	3 – 7.7%	
Treated late type I endoleak	1 – 2.6%	
Chimney occlusion	4 – 10.3% of pts	
5.7% of chimney		
Late type I endoleak (n=3)		
Other devices (n=19)	2 – 10.5%	0.605*
Endurant (n=20)	1 – 5.0%	
Treated late type I endoleak (n=1)		
Other devices (n=19)	0 – 0.0%	1.000*
Endurant (n=20)	1 – 5.0%	

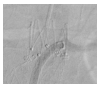
* Fisher's exact test.

The new sealing zone increased to 20,4 ± 4.2 mm

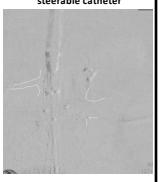
Post-op max AAA diameter decreased of 1,6 mm (p= 0,486)

Chimney occlusion: pts 10,3%
chimney 5,7%

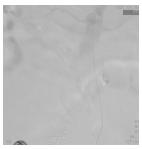
AAA with Aorto Caval Fistula – Haemodynamic instability



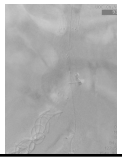
Chimney on LRA with steerable catheter



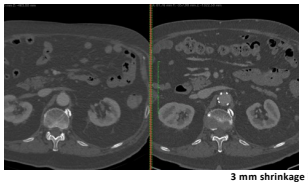
T1AEL persistence after HeliFX

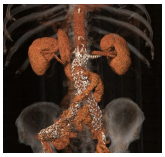


T1EL after EVAR with suprarenal fixation

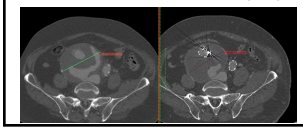


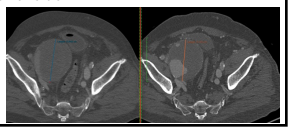
AAA with Aorto Caval Fistula – Haemodynamic instability



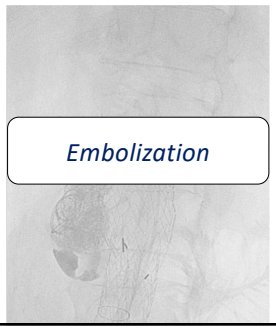


3 mm shrinkage in 6 months





Embolization



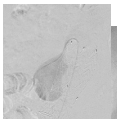
Effectiveness of Intra-Arterial Aneurysm Sac Embolization for Type Ia Endoleak after Endovascular Aneurysm Repair

Elena Marchiori, MD, Monika Herten, PhD, Michel Bosiers, MD, Arne Schwindt, MD, Theodosios Bisdas, MD, PhD, Martin Austermann, MD, PhD, Giovanni Torsello, MD, PhD, and Konstantinos Stavroulakis, MD

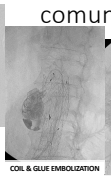
J Vasc Interv Radiol 2019; ■:1–8

- Freedom from sac enlargement:
  -76% Overall
  -72% glue/-80% coils/-80% mix glue/ coils
- Sac shrinkage 38% of patients
- Freedom from EL related interventions 70%
- Very selected cases
- Good Sealing assessed
- Ideal for small leak in Standard EVAR or for gutter-related type I endoleak
- Avoid multiple attempts (infection risk)

T1EL sustained by small comunication

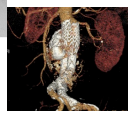


CATHETERIZATION OF SAC



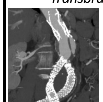
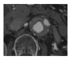
COIL & GLUE EMBOLIZATION

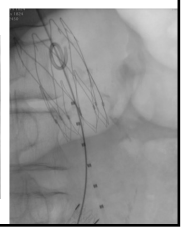
FINAL RESULT



T1AEL + TII (IMA) after Ovation Alto for circumferential polymer ring loss of adherence

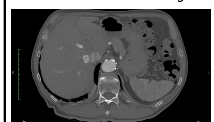
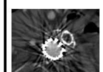
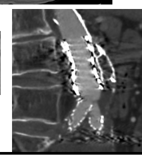
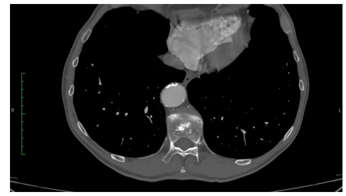
Transbrachial stenting with VBX and plugging of the circumferential infolding + IMA embolization

T1AEL + TII (IMA) after Ovation Alto for circumferential polymer ring loss of adherence

Transbrachial stenting with VBX and plugging of the circumferential infolding + IMA embolization

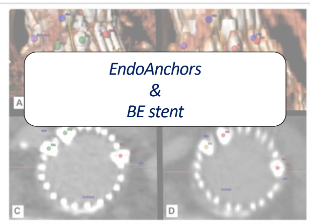





A multicenter experience with infected abdominal aortic endograft explantation

Xavier Chaufour, MD, PhD,[a] Julien Gaudric, MD,[b] Yann Goueffic, MD, PhD,[c] Réda Hassen Khodja, MD,[d] Patrick Feugier, MD, PhD,[e] Sergei Malikov, MD,[f] Guillaume Beraud, MD, PhD,[g] *and* Jean-Baptiste Ricco, MD, PhD,[h] for the AURC (French University Surgeons Association) collaborators,*
Toulouse, Paris, Nantes, Nice, Lyon, Nancy, and Poitiers, France

ABSTRACT
Objective: Endovascular aneurysm repair (EVAR) is widely used with excellent results, but its infectious complications can be devastating. In this paper, we report a multicenter experience with infected EVAR, symptoms, and options for explantation and their outcome.
Methods: We have reviewed all consecutive endograft explants for infection at 11 French university centers following EVAR, defined ... f clinical findings, cultu...
Results: Thirty ... patients (18%) present... cluding catheter-relat... R, eight patients unde... of index EVAR and one... etween the first clinic... ommon presenting ch... fixation was present i... on in 12 patients (36%)... itu in 30 patients and extra-anatomic bypass in 3 patients. In situ conduits were aortic cryopreserved allografts in 23, polyester silver graft in 5, and autogenous femoral vein in 2. Microbiology specimens obtained from the endograft and the aneurysm were positive in 24 patients (74%). Gram-positive organisms were the most commonly found in 18 patients (55%). Early mortality (30 days or in the hospital) was 39% (n = 13) in relation to graft blowout (n = 3), multiple organ failure (n = 6), colon necrosis (n = 3), and peripheral embolism (n = 1). At 1 year, the rates of patient survival, graft-related complications, and reinfection were 44%, 10%, and 5%, respectively.
Conclusions: Abdominal aortic endograft explantation for infection is high risk and associated with graft-enteric fistula in one-third of the cases. Larger multicenter studies are needed to better understand the risk factors and to improve preventive measures at index EVAR and during follow-up. (J Vasc Surg 2016;■:1-9.)

30% OF PATIENTS HAD AN ENDO REINTERVENTION (90% EMBOLIZATION) BEFORE INFECTION



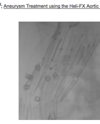
EndoAnchors
&
BE stent

J Vasc Surg. 2014 Oct;60(4):885-92.e2. doi: 10.1016/j.jvs.2014.04.063. Epub 2014 Jul 31.

Results of the ANCHOR prospective, multicenter registry of EndoAnchors for type Ia endoleaks and endograft migration in patients with challenging anatomy.

Jordan WD Jr[1], Mehta M[2], Varnagy D[3], Moore WM Jr[4], Arko FR[5], Joye J[6], Ouriel K[7], de Vries JP[8]; Aneurysm Treatment using the Heli-FX Aortic Securement System Global Registry (ANCHOR) Workgroup Members.

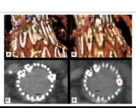
- EARLY RESULTS
  - TECHNICAL SUCCESS 90,9%
  - ABSENCE OF TYPE I EL87,0%
- FOLLOW-UP
  - REINT FOR TYPE I EL 9,1%



- CONS → Distance between graft and aorta < 2mm
  Thrombus/calcification

Sustainability of Individual EndoAnchor Implants in Therapeutic Use to Treat Type Ia Endoleak After Endovascular Aneurysm Repair Journal of Endovascular Therapy 2019

No sign changes in penetration after a median time of 13 months in 71,1% of patients



The Long-term Durability of Intra-operatively Placed Palmaz Stents for the Treatment of Type Ia Endoleaks After EVAR of Abdominal Aortic Aneurysm

M. Abdulrasak, T. Resch, B. Sonesson, J. Holst, T. Kristmundsson, N.V. Dias *
Vascular Center, Skåne University Hospital, Malmö, Sweden

Eur J Vasc Endovasc Surg (2016) ■, 1–8

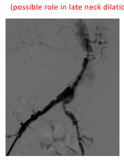
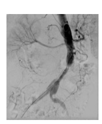
-Ideal for lack of circumf. apposition and good sealing length

-Low data on long term follow up

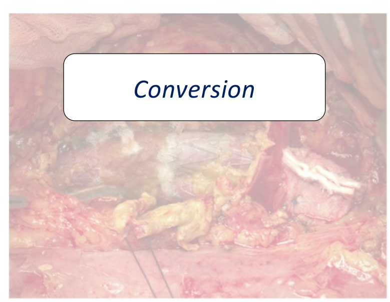
-Minimal SG diameter increase

-14% of PS migration

-Ideal for bail-out/Acute setting (possible role in late neck dilation)

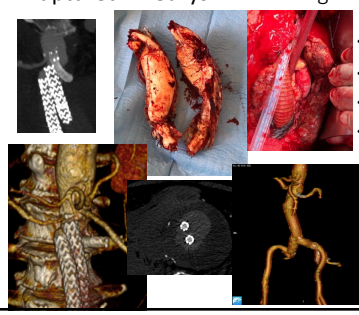
AZIENDA OSPEDALIERA SAN CAMILLO FORLANINI



Conversion

AZIENDA OSPEDALIERA SAN CAMILLO FORLANINI

Ruptured Aneurysm after single Ch-EVAS



- No EV space
- Accept Surg risk
- Emergency cases
- Refractory to EV

Conclusions

- Conservative approach for T1EL has a restricted space (In IFUs repair)
- Late T1EL can be due to several mechanism
- The strategy choice relies on the mechanism wich sustains the T1EL
- Cuffs—> migration
- FEVAR/BEVAR → neck evolution
- Embolization→ Small leak with evident communication
- Endovascular strategies preferable to open conversion